each conductive layer are connected to portions of other conductive layers by electrical pathways called "plugs." The liner layers are formed between each conductive layer and each dielectric material layer to prevent the conductive material from diffusing into the dielectric material layer. The liner layer inhibits a conductive layer from diffusing into an underlying dielectric and short circuiting with an adjacent conductive layer. Of course, such short circuit formations are likely to be detrimental to semiconductor performance. In particular note, copper, a common conductive material used in semiconductor devices, diffuses very aggressively into silicon dioxide. The thickness and composition of the conductive and liner layers must be formed under extremely small margins of error. Thus, systems capable of testing the characteristics of these layers are very important.

IN THE CLAIMS:

[All pending claims have been reproduced below for the convenience of the Examiner.]

Please CANCEL claims 5, 10, 19, and 20 without prejudice or disclaimer.

Please AMEND claim 1 and 11 as follows:

1. (Once Amended) An apparatus for measuring film stack characteristics of a sample, the apparatus comprising:

a beam generator configurable to direct a charged particle beam towards the sample such that the charged particle beam penetrates at least two layers of the film stack, the charged particle beam causing X-rays to emanate from the sample; and

a first and a second wavelength dispersive X-ray detector positioned above the sample wherein each detector detects X-rays about a different characteristic emission level, wherein the X-rays emanate from the sample.

2. The apparatus as recited in claim 1 wherein the first X-ray detector is configured to detect X-rays of a specific energy level.

3. The apparatus as recited in claim 1 wherein the first X-ray detector is a wavelength dispersive system.

4. The apparatus as recited in claim 3 wherein the wavelength dispersive system contains a reflective surface and a sensor, the reflective surface configured to direct X-rays of a predetermined energy level to the sensor.

6. The apparatus as recited in claim 1 wherein a conductive film layer and a liner film layer are two of the at least two layers that are penetrated by the charged particle beam.

7. The apparatus as recited in claim 1 further comprising a processor linked to the beam generator and to the first X-ray detector.

8. The apparatus as recited in claim 7 wherein the processor is configured to control the first X-ray detector so that it detects X-rays of a specific energy level.

9. The apparatus as recited in claim 7 wherein the processor is configured to control the beam generator so that the charged particle beam directed to the sample penetrates at least a conductive film layer and a liner film layer of the sample.

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11. (Once Amended) A method for measuring at least one characteristic of a film stack on a sample, the method comprising:

directing a charged particle beam towards the sample such that the charged particle beam penetrates at least two layers of the film stack, the charged particle beam causing X-rays to emanate from the sample; and

detecting at least a portion of the X-rays emanating from the sample about two different characteristic emission levels using a first and a second wavelength dispersive X-ray detector which are positioned above the sample.

12. The method for measuring as recited in claim 11, further comprising configuring the first X-ray detector to detect X-rays of a specific energy level.

13. The method for measuring as recited in claim 11 wherein the first X-ray detector is a wavelength dispersive system.

14. The method for measuring as recited in claim 13 further comprising positioning a reflective surface contained within the wavelength dispersive system in an orientation to direct X-rays of a predetermined energy level to a sensor contained within the wavelength dispersive system.

16. The method for measuring as recited in claim 11, the method further comprising selecting a charged particle beam energy and a charged particle beam current at which the charged particle beam will be produced.

17. The method for measuring as recited in claim 11, the method further comprising:

collecting data resulting from the detected X-rays; and

analyzing the data to determine film stack characteristics.

18. The method for measuring as recited in claim 11 wherein a conductive film layer and a liner film layer are two of the at least two layers that are penetrated by the charged particle beam.

21. A method of determining film stack characteristic values of a sample, the method comprising:

obtaining raw data related to the film stack characteristic values from a wavelength dispersive system which detects X-rays emanating from the sample;

selecting a set of estimated film stack characteristic values;

obtaining predicted data by solving equations which model a film stack configuration using the set of estimated film stack characteristic values;

comparing the predicted data against the raw data;

selecting a new set of estimated film stack characteristic values when the difference between the predicted data and the raw data is larger than a predetermined margin of error; and

obtaining a new set of predicted data by solving equations which model the film stack configuration using the new set of estimated film stack characteristic values when the difference between the predicted data and the raw data is larger than the predetermined margin of error.

22. The method of determining film stack characteristic values as recited in claim 21 further comprising recording the set of estimated film stack characteristic values when the difference between the predicted data and the raw data is equal to or smaller than the predetermined margin of error.

23. The method of determining film stack characteristic values as recited in claim 21 wherein the raw and predicted data represent a count value of X-rays having a specific energy level, the count value being the total number of X-rays received by the wavelength dispersive system over a period of time.

24. The method of determining film stack characteristic values as recited in claim 21 wherein the estimated film stack characteristic values represent a thickness and a composition of at least two layers within the film stack.

25. The method of determining film stack characteristics as recited in claim 24 wherein a conductive layer and a liner layer are two of the at least two layers within the film stack.

26. A computer-readable medium comprising computer code for determining film stack characteristic values of a sample, the computer-readable medium comprising:

obtaining raw data related to the film stack characteristic values from a wavelength dispersive system which detects X-rays emanating from the sample;

selecting a set of estimated film stack characteristic values;

obtaining predicted data by solving equations which model a film stack configuration using the set of estimated film stack characteristic values;

comparing the predicted data against the raw data;

selecting a new set of estimated film stack characteristic values when the difference between the predicted data and the raw data is larger than a predetermined margin of error; and

obtaining a new set of predicted data by solving equations which model the film stack configuration using the new set of estimated film stack characteristic values when the difference between the predicted data and the raw data is larger than the predetermined margin of error.

27. The computer-readable medium as recited in claim 26 further comprising recording the set of estimated film stack characteristic values when the difference between the predicted data and the raw data is equal to or smaller than the predetermined margin of error.

28. The computer-readable medium as recited in claim 26 wherein the raw and predicted data represent a count value of X-rays having a specific energy level, the count value being the total number of X-rays received by the wavelength dispersive system over a period of time.

29. The computer-readable medium as recited in claim 26 wherein the estimated film stack characteristic values represent a thickness and a composition of at least two layers of the film stack.

30. The computer-readable medium as recited in claim 29 wherein a conductive layer and a liner layer are two of the at least two layers of the film stack.

Please <u>ADD</u> the following new claims:

-- 31. (Added Claim) An apparatus as recited in claim 1 wherein each of the characteristic emission levels correspond to a single layer of the film stack.

32. (Added Claim) An apparatus as recited in claim 1 wherein each of the characteristic emission levels correspond to a different layer of the film stack.

33. (Added Claim) A method as recited in claim 11 wherein each of the characteristic emission levels correspond to a single layer of the film stack.

34. (Added Claim) A method as recited in claim 11 wherein each of the characteristic emission levels correspond to a different layer of the film stack. --